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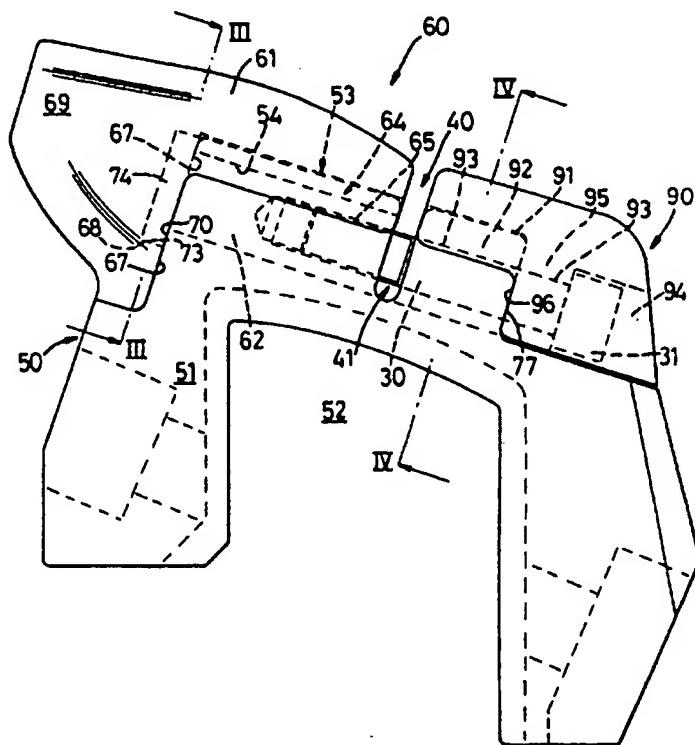
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(54) Title: MINERAL BREAKER

(57) Abstract

A mineral breaker including at least one breaker drum having a plurality of breaker teeth projecting generally radially therefrom, the breaker drum being rotatably mounted for rotation in a given direction to effect breakage of mineral, each breaker tooth including a main body projecting generally radially from the drum axis and having a terminal end upon which a removable tip assembly (60) is located, the tip assembly including a tip body (61) slidably mounted by co-operating key formations (62, 54) on said terminal end of the main body and the tip body, the key formations permitting slidable movement of the tip body (61) relative to the main body (51) generally in a circumferential direction of said drum, the key formation on the main body comprising a groove (54) extending generally circumferentially along said terminal end of the main body and the key formation on the tip body comprising a projection (62) formed on said tip body, the main body and tip body having co-operating abutment faces (67, 70) for limiting slidable movement of the tip body along said groove in a circumferential direction opposite to said given rotation of the drum, and clamping means (30) co-operating with said main body and said tip body to move the tip body along said groove so as to engage said co-operating abutment faces.



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MINERAL BREAKER

The present invention relates to a mineral breaker including a breaker having replaceable teeth.

5

The invention is in particular concerned with mineral breakers of the type described in our patents GB 2170424, EP 0096706 and EP 0167178 in which mineral is broken by a snapping action.

- 10 In mineral breakers of this type a pair of breaker drums are provided in which individual teeth project generally radially from the axis of the drum.

- The tooth construction described in the above patents includes a tooth core in the form of an arm which projects generally radially from the axis and
15 a sheath or tooth cap which covers the tooth core.

The core or arm is made from an impact resistant cast metal and the sheath is made of a wear resistant material such as a high manganese content steel.

20

When the tooth sheath has worn it is necessary to replace the entire sheath. This can be a time consuming operation, particularly with large mineral breakers.

- 25 It is a general aim of the present invention to provide a mineral breaker having breaker teeth including an easily removable tooth tip.

- According to one aspect of the present invention there is provided a mineral breaker including at least one breaker drum having a plurality of
30 breaker teeth projecting generally radially therefrom, the breaker drum

being rotatably mounted for rotation in a given direction to effect breakage of mineral, each breaker tooth including a main body projecting generally radially from the drum axis and having a terminal end upon which a removable tip assembly is located, the tip assembly including a tip body

5 slidably mounted by co-operating key formations on said terminal end of the main body and the tip body, the key formations permitting slidable movement of the tip body relative to the main body generally in a circumferential direction of said drum, the key formation on the main body comprising a groove extending generally circumferentially along said

10 terminal end of the main body and the key formation on the tip body comprising a projection formed on said tip body, the main body and tip body having co-operating abutment faces for limiting slidable movement of the tip body along said groove in a circumferential direction opposite to said given rotation of the drum, and clamping means co-operating with

15 said main body and said tip body to move the tip body along said groove so as to engage said co-operating abutment faces.

Preferably the clamping means comprises a bolt which extends longitudinally of said groove and which is screw threadedly received in

20 screw threaded bore extending longitudinally along said projection.

Preferably the main body and/or the tip body are arranged to permit access to a side portion of the bolt to thereby enable the bolt to be severed, for example by a blow torch or a saw.

25 Preferably the tip assembly includes a second tip body having a projection slidably keyed within said groove, the second tip body being insertable into said groove in the same circumferential direction as the direction of rotation of the drum in said given direction, the second tip body and said main body having co-operating abutment faces for limiting insertion of the

30 second body along said groove, said clamping means being arranged to

simultaneously move both tip bodies toward one another along said groove and engage the respective co-operating abutment faces.

The main body may comprise an arm projecting generally radially of the
5 drum or may comprise a tooth cap mounted upon an arm projecting generally radially of the drum; the tooth cap may for example, be of the construction described in GB 2170424, or EP 0096706.

Various aspects of the present invention are hereinafter described with
10 reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a mineral breaker with which the present invention is concerned;

Figure 2 is a cross-sectional view of a first embodiment according
15 to the present invention;

Figure 3 is an enlarged side view of part of a breaker tooth shown in Figure 2;

Figure 4 is a part section along line III-III in Figure 3;

Figure 5 is a part section along line IV-IV in Figure 3;

20 Figures 4a and 5a are views similar to Figures 4 and 5 respectively showing a modification of the tip bodies;

Figure 6 is a part broken away side view of a mineral breaker including breaker teeth according to a second embodiment of the present invention.

25 A mineral breaker 5 is schematically illustrated in Figure 1 and 2 includes a pair of breaker drums 8 rotatably mounted in a housing 9. The drums 8, in use, rotate in opposite directions to direct mineral to be broken between themselves, the breaker teeth 10 on respective drums co-operating with one another to break down oversized mineral.

A more detailed description of a preferred construction of each breaker drum is described in patent specifications EP 0096706 and GB 2170424 to which reference should be made. Generally, each breaker drum includes a series of radially projecting teeth spaced both circumferentially and axially along the drum. The teeth are formed on a plurality of ring assemblies which are mounted side by side on a common shaft 19 to define the breaker drum. Each ring assembly includes an annular portion 18 from which radially project tooth arms or cores 49 upon which tooth caps are mounted. The teeth are therefore arranged in circumferentially extending groups which are spaced along the axis of the drum.

In Figures 2 and 3 there is illustrated a tooth cap 50 of the type described in GB 2170424 for mounting on a tooth core of a ring assembly. Reference should therefore be made for a fuller description of the ring assembly.

The tooth cap 50 includes a main body 51 having an internal pocket 52 for seating upon a tooth core 49 as described in GB 2170424.

The cap 50 includes a replaceable tip assembly 60 according to a first embodiment of the present invention. The main body 51 has a terminal end 53 having formed therein a groove 54. The groove 54 extends preferably along the entire length of the terminal end 53 in a generally circumferential direction of the breaker drum.

25

The tip assembly 60 includes a first main tip body 61 of elongate form which includes a pocket 64 which houses projection 62 which is received within the groove 54. The groove 54 and projection 62 are shaped to define a key formation; ie. groove 54 defines a keyway for projection 62.

30 The projection 62 and groove 54 thereby co-operate to prevent the tip

body 61 moving in a radial direction away from the main body 51. Preferably as shown, the groove 54 and projection 62 are circular in cross-section; it will be appreciated however that other complimentary cross-sectional shapes may be adopted which enable relative slidable movement circumferentially of the drum whilst holding the tip assembly 5 radially captive relative to the cap 50.

- The projection 62 is solid in cross-section and includes a screw threaded bore 65 extending partly along its length. The tip body 61 includes a shoulder 67 defined by an end wall of pocket 64 which extends generally laterally to the direction of insertion of the tip body 61 along the groove 54 and which co-operates with a shoulder 70 formed on the main body 51 to limit the insertion of the tip body 61.
- 15 The tip body 61 also preferably includes an abutment surface 68 which co-operates with an abutment surface 73 formed on the main body to resist radially outwardly directed force applied to the breaker nose 69 of the tip body 61 during use.
- 20 Preferably abutment surface 68 is defined by an annular recess formed internally of the tip body 61 adjacent to the end wall of pocket 64 and abutment surface 73 is defined by a projection in the form of an annular collar 74 integrally formed with the main body 51.
- 25 A second tip body 90 is preferably provided. The second tip body 90 includes a first pocket 91 housing a projection 92 which co-operates with groove 54 in a similar manner to projection 62 to define a key formation.

30 The projection 92 includes a through bore 93 extending entirely along its length.

The second tip body 90 includes a second pocket 94 spaced axially from the first pocket 91 to define therebetween a wall 95 through which bore 93 also extends.

- 5 The second tip body 90 includes a laterally extending shoulder 96 defined by an end wall of pocket 91 which abuts against a shoulder 77 formed on the main body 51 to limit insertion of the second body 90 along groove 54.
- 10 A bolt 30 is provided which extends through bore 93 to be screw threadedly received in bore 65. The bolt 30 has a bolt head 31 which is received in pocket 91 and which on tightening engages against wall 95 to urge co-operating shoulders 67, 70 and 77, 96 into contact. Preferably the bolt 30 is a high tensile bolt which is stretched upon tightening in order 15 to resist loosening due to vibration. Accordingly, both tip bodies 61, 90 are clamped against opposing shoulders 70, 77 formed on the main body 51 and so cannot move axially along groove 54. The keying inter-relationship between projections 62 and 92 ensure that the tip bodies cannot move radially away from the main body. The internal sides 64_a 20 and 91_a of the pockets 64, 91 respectively are formed so as to seat upon the opposed side of the main body 51 to thereby transmit radially inwardly directed loadings onto the main body 51.

The tip assembly 60 can be easily assembled upon the main body 51 by 25 sliding tip bodies 61, 90 along the groove 54 in opposite directions and then clamping them in position by use of bolt 30. Removal is easily achieved by a reversal of this process.

Should the bolt 30 become seized and difficult to remove by unscrewing, 30 the assembly is adapted to enable the bolt 30 to be severed and thereby

enable tip bodies 61, 90 to be replaced.

In this respect, the tip bodies 61, 90 are arranged to be longitudinally spaced from one another when clamped upon the main body 51 so as to define a gap 40. The main body 51 is provided with a laterally extending groove 41 which aligns with gap 40, the groove 41 extending across the groove 54 and thereby exposing a portion of the bolt 30.

Accordingly, access may be gained through gap 40 and groove 41 to sever the bolt 30; this may be done by any conventional means such as by cutting using a saw or blow torch.

Both tip bodies 61 and 90 are preferably cast from a suitable wear resistant metal such as a high manganese content steel. The tooth cap body 51 is also cast from the same or similar material.

It will be appreciated that the nose 69 may be of any desired shape suitable for breaking mineral.

The upper portion 61b and 90b of tip bodies 61 and 90 respectively are preferably of a width so as to extend across the entire width of the terminal end 53 of the main body 51, as for example viewed in Figures 4 and 5 respectively. As indicated in Figures 4a and 5a respectively, the upper portions 61b and 90b may have extended skirt portions 61c, 90c which extend radially inwardly to cover the upper sides of the main body 51.

It will be appreciated that the upper portions 61b and 90b will wear away during use and that their radial thickness will reduce. Such reduction in radial thickness will however not affect the ability of the projections 62

and 92 to remain reliably keyed within the groove 54.

In Figure 6 there is shown an alternative arrangement wherein the tip assembly 60 as described above is mounted on the terminal end of a
5 radially directed arm 100.

In Figure 6, the breaker drums are each formed from a plurality of ring assemblies 120 (only one of which is shown for each drum) which are supported on a shaft 121.

10

Each ring assembly 120 is preferably cast from a suitable metal so as to include an annulus 124 from which three arms 100 project. The terminal end of each arm 100 includes the groove 54 and is suitably shaped to receive the tip assembly 60 as described above.

15

Preferably three arms 100 are provided on each ring assembly in order to provide a large gripping distance GD between opposed teeth on opposite drums and to also provide a relatively large depth D. For example, as illustrated, with breaker drums having axes spaced one metre apart, it is
20 possible to provide a gripping distance GD of about 1300 mm and a depth D of about 215 mm.

A breaker bar 200 is located in between and beneath the breaker drums defined by assemblies 120 in order to co-operate with the breaker teeth on
25 each drum in order to break mineral to a predetermined maximum size. The breaker bar 200 is preferably arranged and constructed as described in EP 0246775 to which reference should be made.

It will be appreciated that each ring assembly 120 may include more than
30 3 arms 100 if desired.

CLAIMS

1. A mineral breaker including at least one breaker drum having a plurality of breaker teeth projecting generally radially therefrom, the
5 breaker drum being rotatably mounted for rotation in a given direction to effect breakage of mineral, each breaker tooth including a main body projecting generally radially from the drum axis and having a terminal end upon which a removable tip assembly is located, the tip assembly including a tip body slidably mounted by co-operating key formations on
10 said terminal end of the main body and the tip body, the key formations permitting slidable movement of the tip body relative to the main body generally in a circumferential direction of said drum, the key formation on the main body comprising a groove extending generally circumferentially along said terminal end of the main body and the key
15 formation on the tip body comprising a projection formed on said tip body, the main body and tip body having co-operating abutment faces for limiting slidable movement of the tip body along said groove in a circumferential direction opposite to said given rotation of the drum, and clamping means co-operating with said main body and said tip body to
20 move the tip body along said groove so as to engage said co-operating abutment faces.

2. A mineral breaker according to claim 1 wherein said groove and projection are generally circular in cross-section.
25
3. A mineral breaker according to claim 1 or 2 wherein the clamping means comprises a bolt which extends longitudinally of said groove and which is screw threadedly received in screw threaded bore extending longitudinally along said projection.

4. A mineral breaker according to claim 3 wherein the main body and/or the tip body are arranged to permit access to a side portion of the bolt to thereby enable the bolt to be severed.
5. 5. A mineral breaker according to any preceding claim wherein the co-operating abutment faces comprise a projection and co-operating recess which co-operate to prevent relative radial movement between the main body and tip body.
- 10 6. A mineral breaker according to any preceding claim wherein the tip body has a main body portion located radially beyond said terminal end of the main body, the main body portion being of a width so as to extend across the entire width of said terminal end.
- 15 7. A mineral breaker according to claim 6 wherein the main body portion includes skirt portions which extend radially inwardly to cover the upper sides of the main body.
- 20 8. A mineral breaker according to any preceding claim wherein the tip assembly includes a second tip body having a projection slidably keyed within said groove, the second tip body being insertable into said groove in the same circumferential direction as the direction of rotation of the drum in said given direction, the second tip body and said main body having co-operating abutment faces for limiting insertion of the second body along said groove, said clamping means being arranged to simultaneously move both tip bodies toward one another along said groove and engage the respective co-operating abutment faces.
- 25 9. A mineral breaker according to any preceding claim wherein the main body comprises an arm projecting radially of the drum.

10. A mineral breaker according to any of claims 1 to 8 wherein the main body comprises a tooth cap mounted upon a tooth core in the form of an arm projecting radially of the drum.
- 5 11. A mineral breaker according to any preceding claim wherein each breaker drum including circumferentially extending groups of breaker teeth spaced along the axis of the drum, each group including 3 or 4 breaker teeth spaced circumferentially about the drum.

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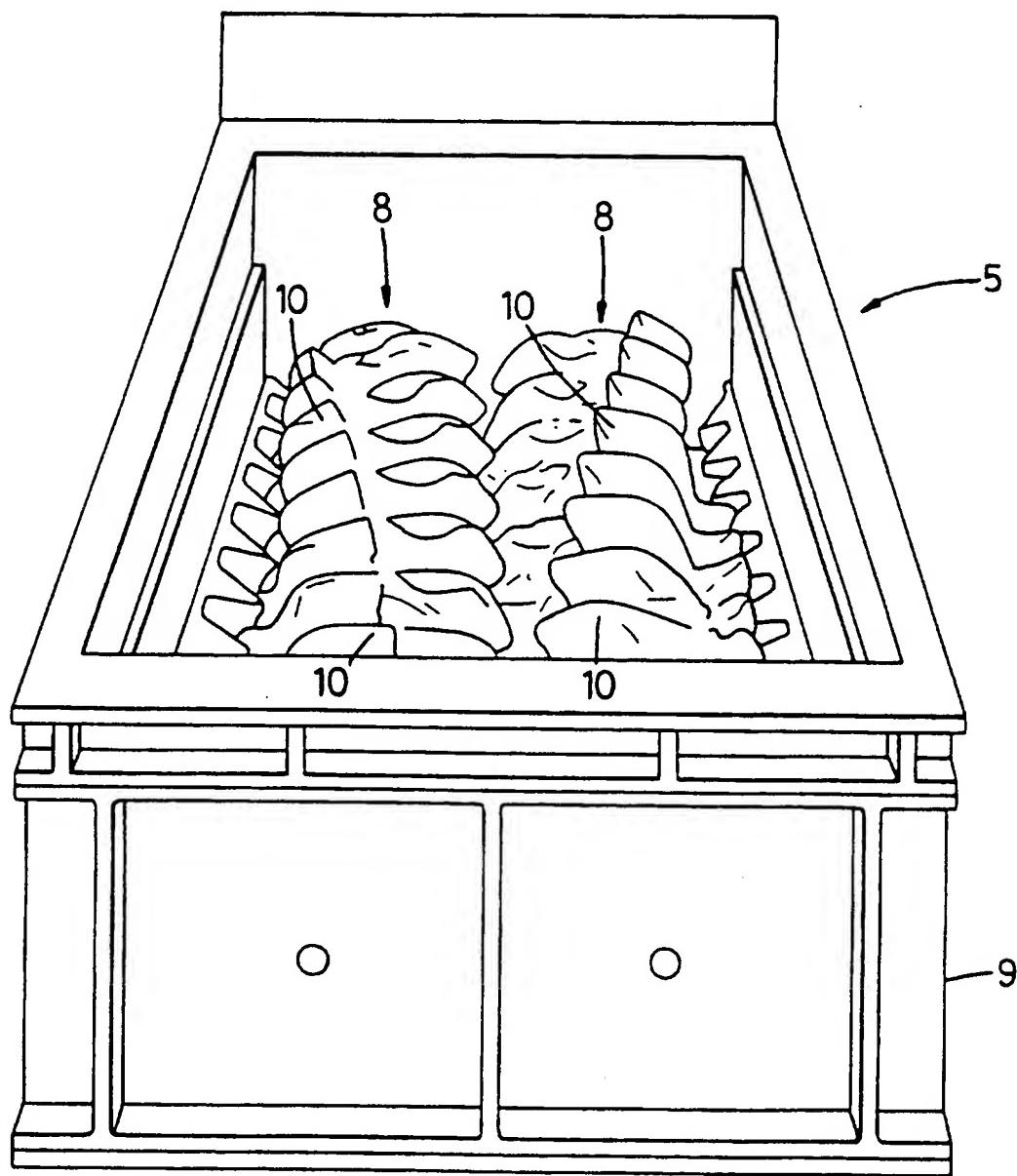


Fig. 1

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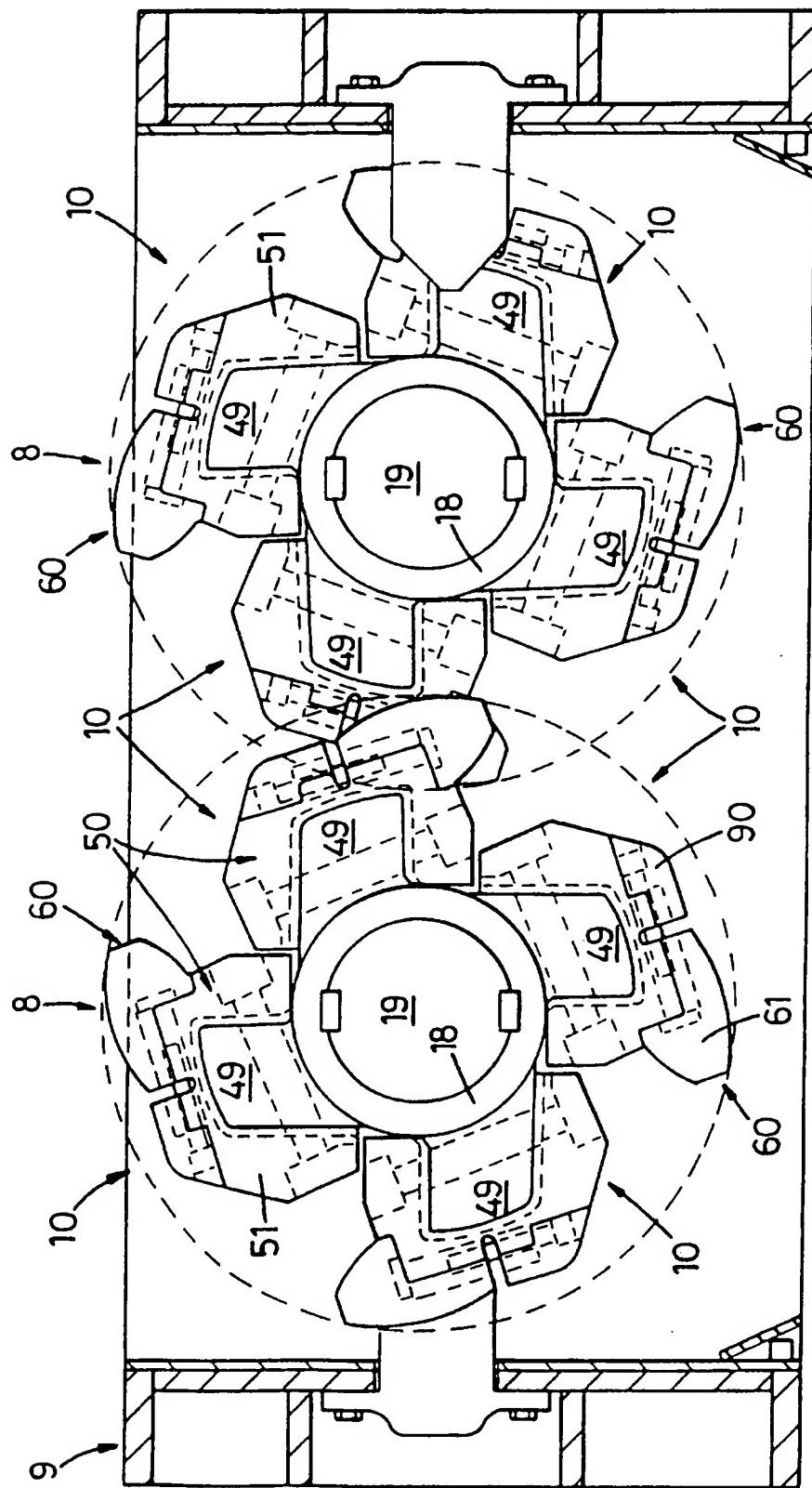


Fig. 2

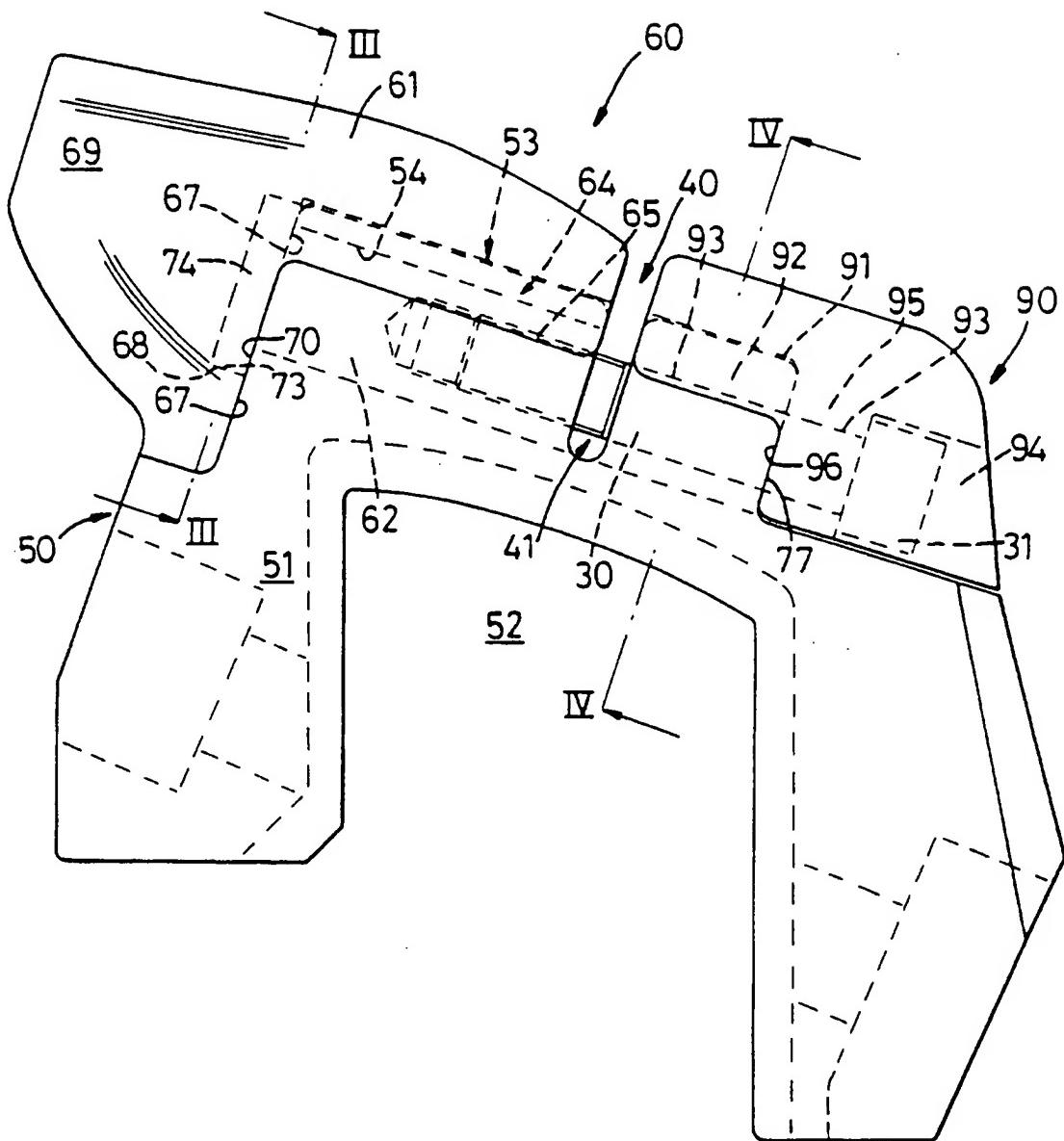


Fig. 3

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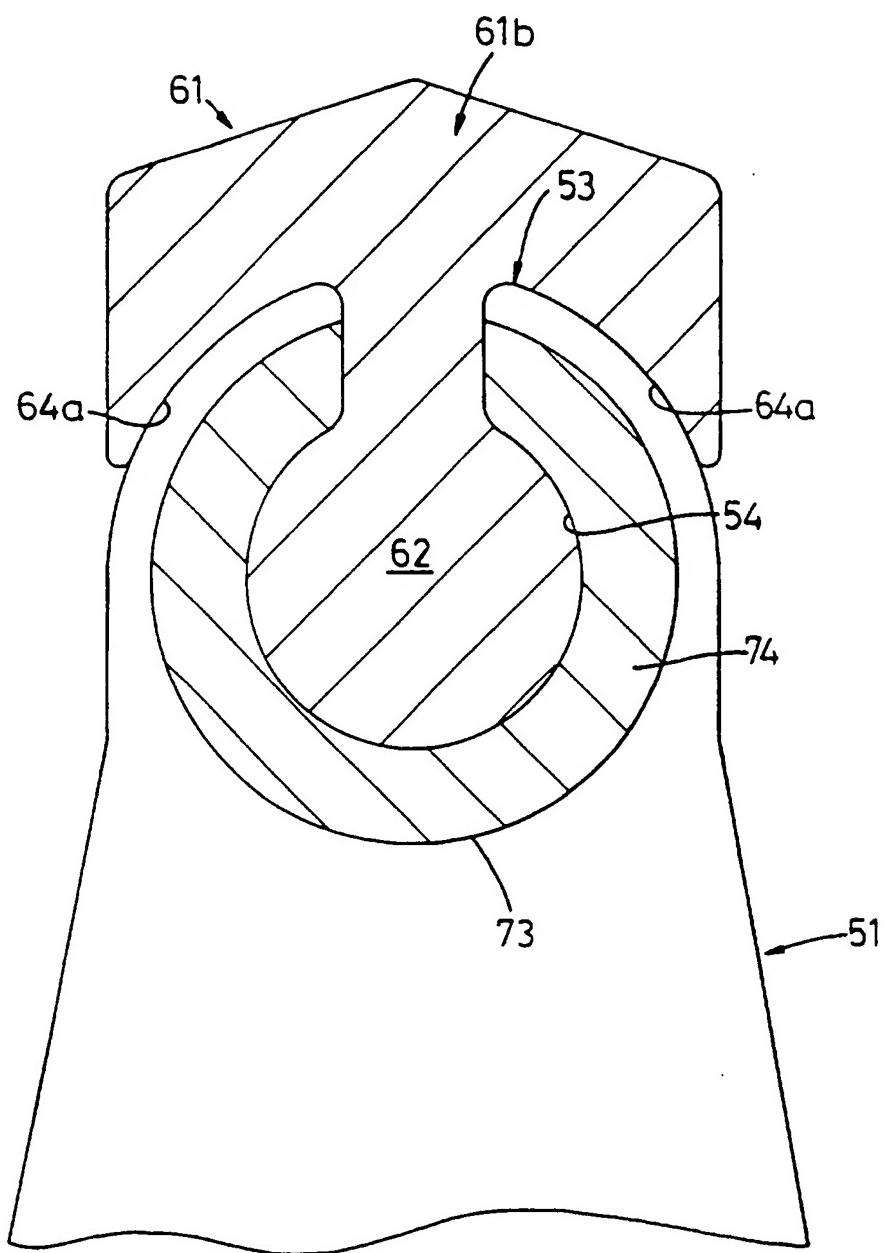


Fig. 4

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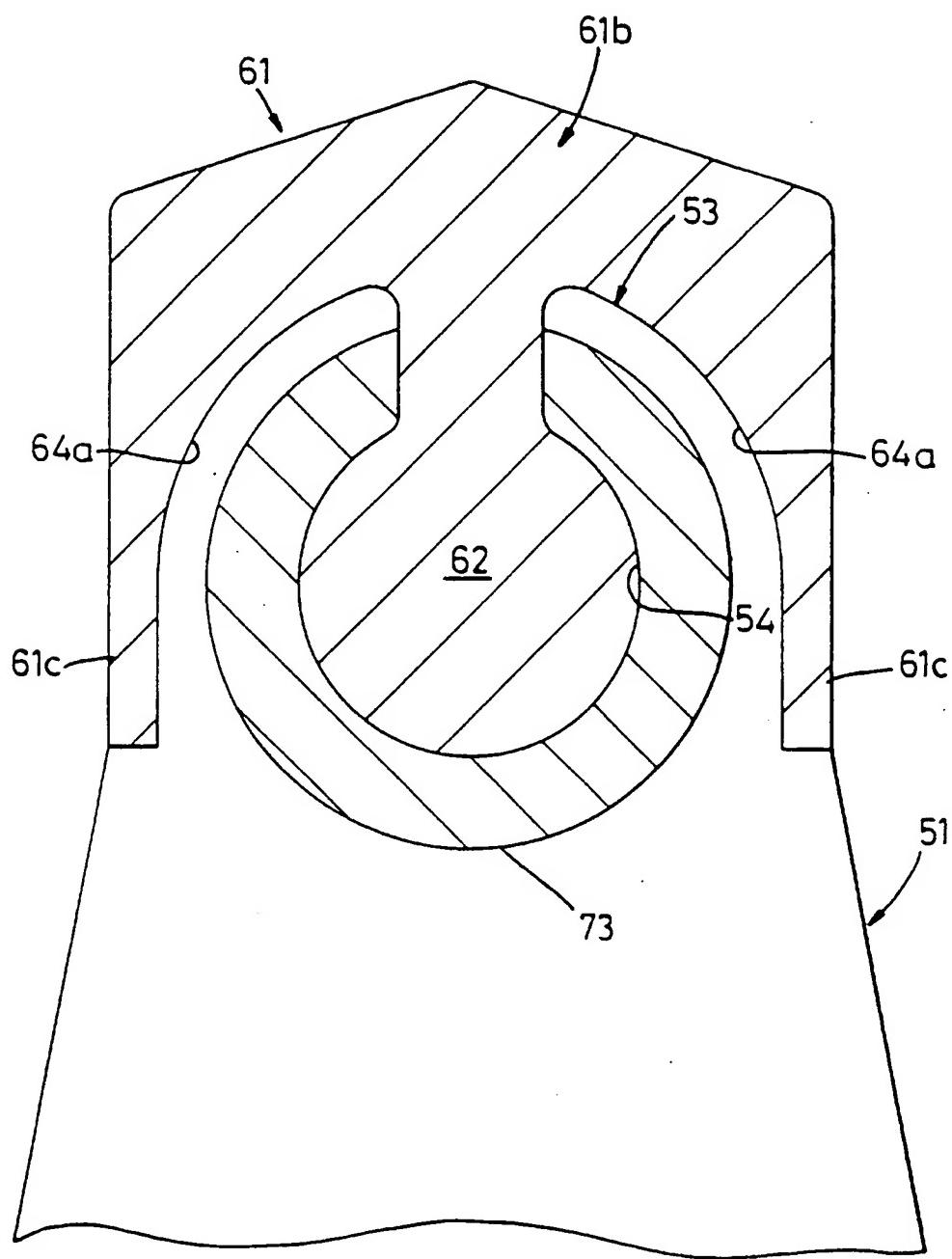


Fig. 4a

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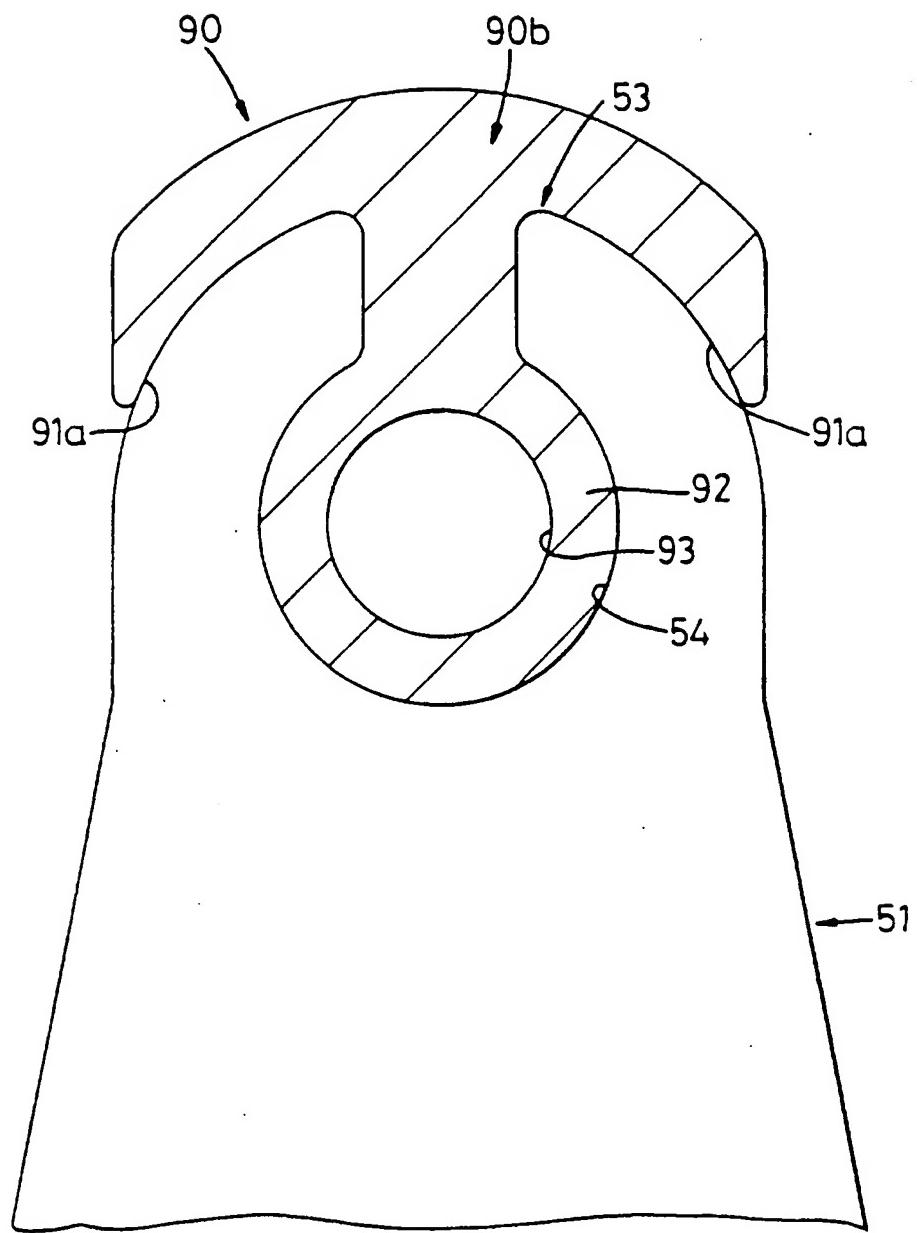


Fig. 5

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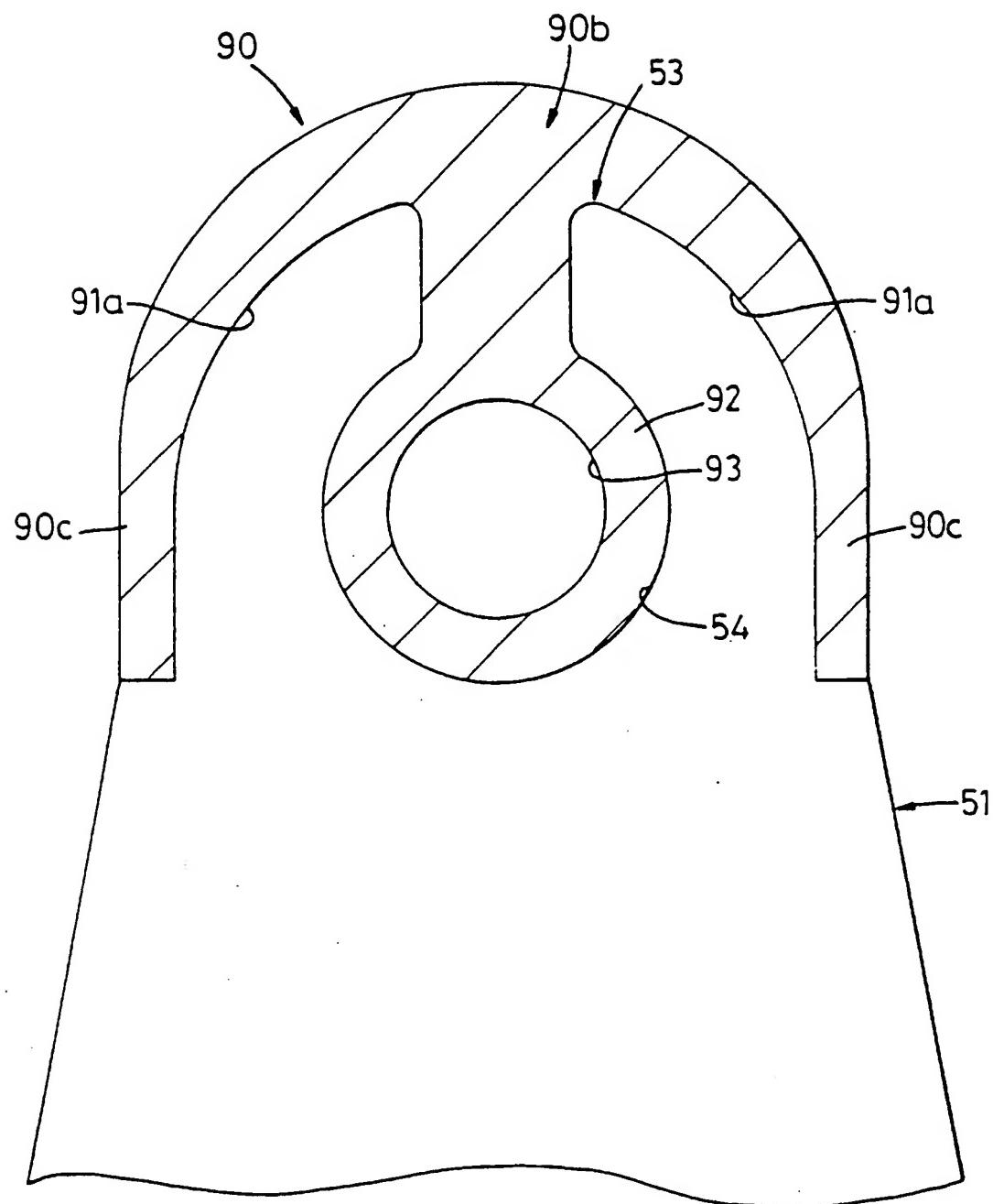


Fig. 5a

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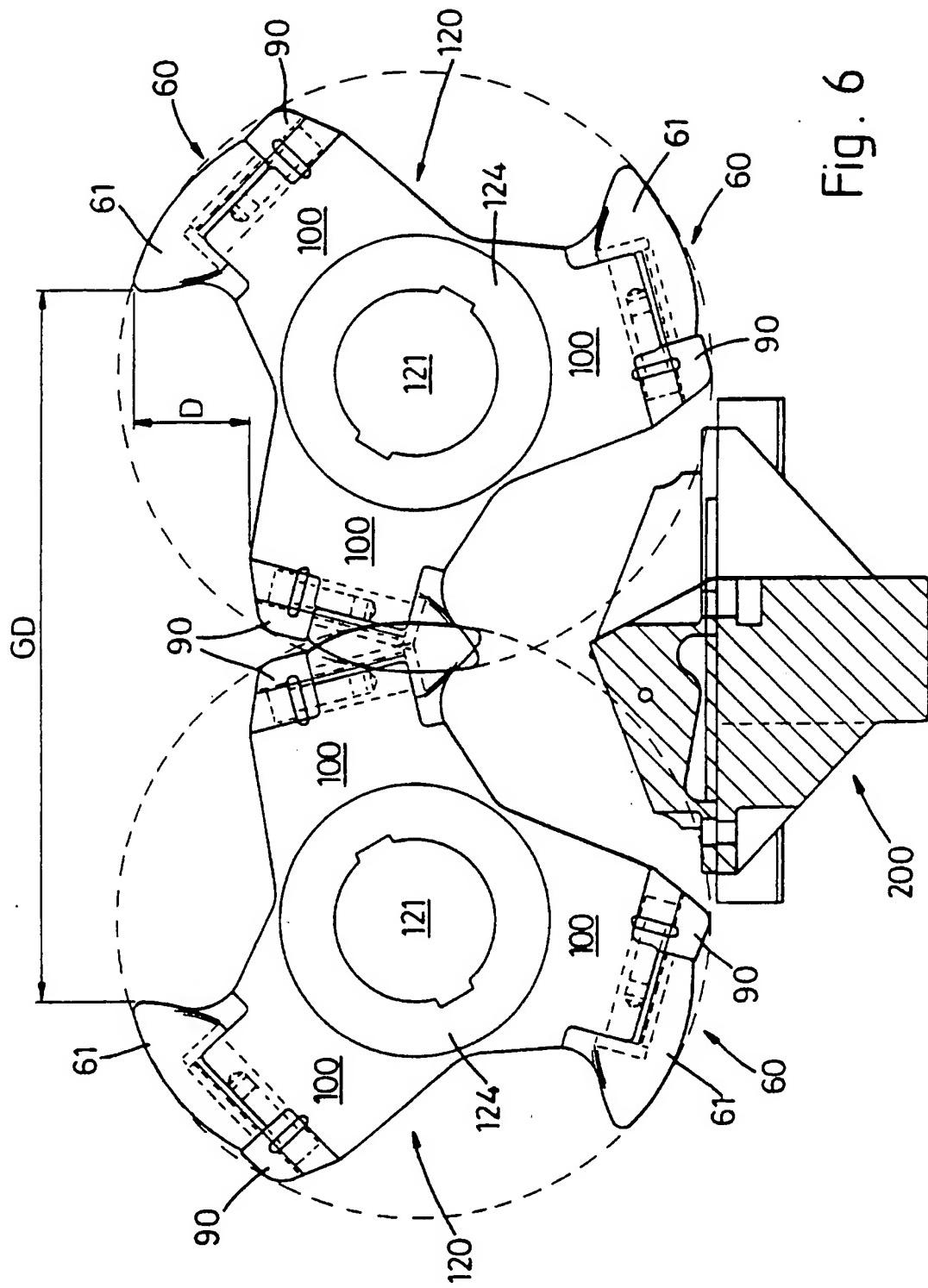


Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 96/00662

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B02C4/30 B02C4/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B02C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|----------|---|-----------------------|
| Y | EP,A,0 114 725 (MMD DESIGN AND CONSULTANCY LTD.) 1 August 1984 see claims 12,15-17; figures 5-9,15 --- | 1,6,9-11 |
| Y | US,A,2 939 640 (T.C. WHISLER) 7 June 1960 see column 2, line 34 - column 3, line 71; figures 1-3 --- | 1,6,9-11 |
| Y | US,A,4 597 538 (R.A. GETZ) 1 July 1986 see column 10, line 14 - column 11, line 2; figures 4-6 --- | 1,9-11 |
| A | DE,U,93 07 323 (WEIMA APPARATEBAU GMBH.) 19 August 1993 see claim 7; figure 3 ----- | 5 |

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 96/00662

| Patent document cited in search report | Publication date | Patent family member(s) | | Publication date |
|--|------------------|-------------------------|---------|------------------|
| EP-A-114725 | 01-08-84 | AU-B- | 566111 | 08-10-87 |
| | | AU-B- | 2355284 | 26-07-84 |
| | | CA-A- | 1231692 | 19-01-88 |
| | | US-A- | 4733828 | 29-03-88 |
| US-A-2939640 | 07-06-60 | NONE | | |
| US-A-4597538 | 01-07-86 | NONE | | |
| DE-U-9307323 | 19-08-93 | NONE | | |